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(54) PROCESS FOR THE REMOVAL OF SOLID PARTICLES FROM A LIQUID STREAM

(71) We, SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V., a company organised under the laws of The Netherlands, of 30 Carel van Bylandtlaan, The Hague, The Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

This invention relates to a process for the removal of solid particles which form a compressible filter cake from a liquid stream, the stream being conducted through a continuous filter, such as a rotary disc or drum filter.

A continuous filter is a filter to which in the filtering zone a continuous liquid stream to be filtered is forwarded.

It is known that in the removal of solid particles from a liquid by filtration the liquid is passed through a filter in which the solid particles are left behind. With filtration in its most elementary form the problem is that when the filter has been in use for some time, a filter cake develops on it, which results in an increased resistance of the filter until finally complete blockage occurs. The yield of the filter in terms of filtered liquid will therefore gradually decrease.

A distinction can be made between two sorts of filter cake, viz. a compressible and a non-compressible type. It is known that with non-compressible filter cakes the yield of filtered liquid in principle increases according as the pressure drop across the filter is increased. With compressible filter cakes, on the other hand, it is seen that once a threshold pressure drop is reached an increased pressure drop across the filter causes no perceptible increase in yield of filtered liquid.

Since the yield of filtered liquid rapidly decreases with compressible filter cakes, ways have been sought to overcome this problem. This search has produced many variants of the continuous filter in which the filter cake is also removed continuously. Two important examples of this type of filter are the rotary disc filter and the rotary drum filter. With both types the pressure drop across the filter can be created by a positive pressure on the pressure side and/or reduced pressure on the discharge side of the filter.

A further problem in the filtration of particles which form compressible filter cakes from a liquid with the aid of a continuous filter is that in spite of the continuous removal of the filter cake the yield of filtered liquid drops relatively rapidly. For instance, when crystallized wax particles are removed from a hydrocarbon oil with a rotary drum filter, it is found that although the filter cake is scraped off and the filter washed in counterflow the drum filter becomes blocked within a period of only a few hours to such an extent that the yield of filtered oil drops below an acceptable minimum. The filter then has to be taken out of service and cleaned, which results in a loss of production.

The present invention aims to provide a method by which the yield of filtered liquid is increased for continuous filters over the period of time until effective blocking occurs and/or by which this period is extended. To this end, the pressure drop across the filter in a filtering zone is increased stepwise not more than once every thirty minutes in the process according to the invention. Surprisingly, it has been found that – although the yield of filtered liquid as a function of time is almost independent of the pressure drop across the filter – a stepwise increase effects an increase in yield each time. Naturally, the yield gradually falls again after each increase, but the observed difference in yield before and after the stepwise increase is found to persist.

In this specification the term stepwise increase refers to an increase which takes place in a jump, i.e. which has the character of a distinct increase in pressure drop effected within a short time – hence clearly some time before a new increase.

According to a preferred embodiment of the invention, the pressure drop across the filter is created by reducing the pressure on

the side of the filter through which the liquid leaves the filter. The liquid usually flows through continuous filters from the outside to the inside, so that in the case of the above-mentioned so-called reduced pressure filter the space round it can remain at atmospheric pressure and therefore does not require an exceptionally strong construction, whilst inside the filter a reduced pressure is maintained. In implementing this feature of the invention, it is advantageous that a relatively small volume is rapidly brought to the new reduced pressure.

In order to benefit most from the effect of the invention, i.e. an increase in yield, it is preferred to pass the liquid stream through the filter in a filtering zone and remove the particles left behind on the filter in a cleaning zone by countercurrent washing, scraping off and/or blowing off with an inert gas in the reverse direction to that of the flow. In this way the filter resistance is continuously kept as low as possible. In addition, the effect of the invention then proves to be substantial.

The present invention can advantageously be used in the removal of wax particles from a hydrocarbon oil.

The removal of wax from mineral oil products, the so-called dewaxing, leads to the formation of compressible filter cakes and even with the continuous removal of the filter cake from a continuous filter, the total period during which the filter can be kept in operation is limited to a few hours. In view of the quantities of liquid to be filtered that are usually handled, the provision according to the invention can result in a considerable saving.

In this dewaxing the stepwise increase in the pressure drop across the filter is preferably carried out in such a way that the pressure drop is increased each time by at least 0.1 bar. This means a considerable restriction indeed in the total number of pressure drop increases possible (the reduced pressure being further reduced each time) in particular with the continuous filters which already have a reduced pressure inside the filter such as those which are usually employed for dewaxing. But it has been found that a few large pressure drop increases have a greater effect than a larger number of smaller pressure drop increases.

In case the invention is applied to a process in which the filter is taken out of service as soon as the quantity of liquid passed through per unit time has dropped below an unacceptable minimum, it is preferred according to the invention to increase the pressure drop across the filter stepwise at most three times over the period between putting the filter into service and withdrawing it from service.

Although differences are found in individual cases, the best result will generally be achieved when each time the pressure drop is increased the rate of the pressure drop increase is at least 1 bar per hour. At too low a rate the result will be small, at too high a rate the cost of the equipment that is required for increasing the pressure drop may become excessive or the filter may even be damaged.

The invention will be further elucidated hereinafter with reference to an example. The accompanying figure is a graph showing the yield of filtered liquid as a function of time for three experiments.

Example

An oil containing 24.7 %w wax in the form of small crystals which produced a compressible filter cake was filtered with the aid of a rotary drum filter in which a reduced pressure was maintained inside the cylindrical filter. The filter was continuously scraped.

As it had been found that the rotational speed of the drum filter has an influence on the oil content of the filter cake and consequently on the yield of filtered oil, the three experiments were carried out at the same rotational speed, i.e. 36 revolutions per hour.

The first experiment was performed at a pressure drop across the filter of 0.8 bar; i.e. the pressure outside the filter was 1.0 bar and inside the filter 0.2 bar. The experiment was started with a clean filter. The yield of filtered oil was continuously determined with continuous scraping off and blowing off of wax from the filter for four hours, after which the experiment was stopped. The result has been shown in the graph (curve A), in which the yield of filtered oil in tonnes per day has been plotted against filtration time in minutes.

The experiment was then repeated with a clean filter and with a pressure drop across the filter of only 0.2 bar (see curve B).

Then, a third experiment was carried out (see curve C), which was started with a clean filter again and with an initial pressure drop across the filter of 0.2 bar. During this third filtration the pressure drop was increased stepwise three times according to the invention, viz. after 70 minutes from 0.2 bar to 0.4 bar, after 130 minutes from 0.4 bar to 0.6 bar and after 190 minutes from 0.6 to 0.8 bar. These stepwise increases of the pressure drop were effected each time within 10 minutes.

The graph shows that at a pressure drop of 0.8 bar the yield is almost equal to the yield at a pressure drop of 0.2 bar (curves A and B); the pressure drop of 0.8 bar initially caused a somewhat higher and subsequently (after about 80 minutes) a somewhat lower yield than the pressure drop of 0.2 bar.

From curve C it is seen that the stepwise

pressure drop increases raise the yield to a level that is higher than that of curves A and B and that the yield is increased in particular during the pressure drop increase proper, whilst the relative increase persists, at least partly, after each pressure drop increase.

It will be clear that the surface area under the curve is a measure of the total yield of filtered liquid and that this total yield is highest for curve C.

WHAT WE CLAIM IS:

1. A process for the removal of solid particles, which form a compressible filter cake, from a liquid stream, the stream being conducted through a continuous filter, such as a rotary disc or drum filter, characterized in that the pressure drop across the filter in a filtering zone is increased stepwise not more than once every thirty minutes.

2. A process according to claim 1, characterized in that the pressure drop across the filter in the filtering zone is created by reduced pressure on the side of the filter whence the liquid leaves the filter.

3. A process according to claim 1 or 2, characterized in that the liquid stream is passed through the filter in the filtering zone and in that the particles left behind on the filter are removed in a cleaning zone, by countercurrent washing, scraping and/or blowing off.

4. A process according to claim 1, 2 or 3, characterized in that wax particles are removed from a hydrocarbon oil.

5. A process according to claim 4, characterized in that the pressure drop is increased each time by at least 0.1 bar.

6. A process according to claim 3, in which the filter is taken out of service as soon as the quantity of liquid discharged per unit time has dropped below an unacceptable minimum, characterized in that the pressure drop across the filter in the filtering zone is increased stepwise at most three times over the period between putting the filter into service and withdrawing it from service.

7. A process according to any one of the preceding claims 1 -6, characterized in that each time the pressure drop is increased the rate of the pressure drop increase is the pressure drop is at least 1 bar per hour.

8. A process as claimed in claim 1 and substantially as hereinbefore described.

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1589004 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*